COMPOSITES ENGINEERING

An International Journal

Editor-in-Chief: DAVID HUI, New Orleans, USA

Volume 1 (1991)

Volume Contents and Author Index

PERGAMON PRESS

Oxford • New York • Seoul • Tokyo

COMPOSITES ENGINEERING

An International Journal

Editor-in-Chief: Professor David Hui, Department of Mechanical Engineering, University of New Orleans, Lakefront, New Orleans, LA 70148, USA. Tel. 504-286-6192. Fax 504-286-7413.

Editorial Board

Gary L. Anderson, US Army Research Office, Research Triangle Park, NC, USA

William M. Banks, University of Strathclyde, Glasgow, UK

Roshdy Barsoum, Office of Naval Research, Arlington, VA, USA

Peter W. R. Beaumont, Cambridge University, UK

Charles Bert, University of Oklahoma, Norman, USA

Victor Birman, University of Missouri-Rolla, St Louis, USA

Alexander Bogdanovich, Latvian SSR Academy of Sciences, Latvia, USSR

A. R. Bunsell, Ecole Nationale Superieure des Mines de Paris, Evry, France

O-Il Byon (Goichi Ben), Nihon University, Chiba, Japan

Shive K. Chaturvedi, Ohio State University, Columbus, USA

Eric Christiansen, NASA Johnson Space Center, Houston, TX, USA

Subhendu K. Datta, University of Connecticut, USA

Feridun Delale, City University of New York, USA

Piyush Dutta, US Army Cold Regions Research Lab., Hanover, NH, USA

Mauro Ferrari, University of California, Berkeley, CA, USA

Alan D. Freed, NASA Lewis Research Center, Cleveland, OH, USA

Faramarz Gordaninejad, University of Nevada, Reno, USA

Carl T. Herakovich, University of Virginia, Charlottesville, USA

Chun-Hway Hsueh, Oak Ridge National Lab., Oak Ridge, TN, USA

Karl U. Kainer, Technical University of Clausthal, Germany

Rakesh K. Kapania, Virginia Polytechnic Institute and State University, Blacksburg, USA

Kozo Kawata, Science University of Tokyo, Japan

Anthony Kelly CBE, FRS, FEng, University of Surrey, Guildford, UK

Akira Kobayashi, University of Tokyo, Japan

James Koury, Edwards Air Force Base, CA, USA

Alan Nettles, NASA Marshall Space Flight Center, Huntsville, AL, USA

Nicholas J. Pagano, Wright Patterson Air Force Base, OH, USA

Marek-Jerzy Pindera, University of Virginia, Charlottesville, USA

Clarence C. Poe, NASA Langley Research Center, Hampton, VA, USA

Yapa Rajapakse, Office of Naval Research, Arlington, VA, USA

Franz G. Rammerstorfer, Vienna University of Technology, Austria

H. M. Shang, National University of Singapore, Singapore

George J. Simitses, University of Cincinnati, OH, USA

Kostas P. Soldatos, University of Nottingham, UK

James Starnes, NASA Langley Research Center, Hampton, VA, USA

Yehuda Stavsky, Technion—Israel Institute of Technology, Haifa, Israel

Stephen R. Swanson, University of Utah, Salt Lake City, USA

Ramesh Talreja, Georgia Institute of Technology, Atlanta, GA, USA

Rod C. Tennyson, University of Toronto, Canada

Geoffrey J. Turvey, Lancaster University, UK

Viggo Tvergaard, Technical University of Denmark, Lyngby, Denmark

Masuji Uemura, Nihon University, Tokyo, Japan

Sokichi Umekawa, Science University of Tokyo, Japan

Valery V. Vasiliev, Moscow Institute of Aviation, USSR

Jack R. Vinson, University of Delaware, Newark, USA

Anthony M. Waas, University of Michigan, Ann Arbor, USA

James Whitney, University of Dayton, OH, USA

Jerry G. Williams, Conoco Inc., Ponca City, OK, USA

Julian J. Wu, US Army Research Office, Research Triangle Park, NC, USA

Spencer Wu, Air Force Office of Scientific Research, Washington DC, USA

Publishing, Subscription and Advertising Offices: Pergamon Press plc, Headington Hill Hall, Oxford OX3 0BW, U.K.; Pergamon Press, Inc., 395 Saw Mill River Road, Elmsford, NY 10523, U.S.A.

Published 8 issues/annum in 1992, in January, February, April, May, July, August, October and November. Annual Institutional Subscription Rate (1992): £215 (US$340). Two-year Institutional Rate (1992/93): £408 (US$646). Sterling prices are definitive. US dollar prices are quoted for convenience only, and are subject to exchange rate fluctuation. Prices include postage and insurance and are subject to change without notice. Personal subscription rate for those whose library subscribes at the regular rate is available on request. Subscription rates for Japan include despatch by air and prices are available on request. Subscription enquiries from customers in North America should be sent to: Pergamon Press, Inc., 395 Saw Mill River Road, Elmsford, NY 10523, U.S.A., and for the remainder of the world to: Pergamon Press plc, Headington Hill Hall, Oxford OX3 0BW, U.K.

Back Issues

Back issues of all previously published volumes, in both hard copy and on microform, are available direct from Pergamon Press offices.

Copyright © 1991 Pergamon Press plc

It is a condition of publication that manuscripts submitted to the journal have not been published and will not be simultaneously submitted or published elsewhere. By submitting a manuscript, the authors agree that the copyright for their article is transferred to the publisher if and when the article is accepted for publication. However, assignment of copyright is not required from authors who work for organizations which do not permit such assignment. The copyright covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproductions, microform or any other reproductions of similar nature, and translations. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, electrostatic, magnetic tape, mechanical, photocopying, recording or otherwise, without permission in writing from the copyright holder.

Whilst every effort is made by the publishers and editorial board to see that no inaccurate or misleading data, opinion or statement appears in this journal, they wish to make it clear that the data and opinions appearing in the articles and advertisements herein are the sole responsibility of the contributor or advertiser concerned. Accordingly, the publishers, the editorial board and editors and their respective employees, officers and agents accept no responsibility or liability whatsoever for the consequences of any such inaccurate or misleading data, opinion or statement.

PHOTOCOPYING INFORMATION FOR USERS IN THE U.S.A.

The Item-fee Code for this publication indicates that authorization to photocopy items for internal or personal use is granted by the copyright holder for libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service provided the stated fee for copying, beyond that permitted by Section 107 or 108 of the United States Copyright Law, is paid. The appropriate remittance of $3.00 per copy per article is paid directly to the Copyright Clearance Center Inc., 27 Congress Street, Salem, MA 01970.

PERMISSION FOR OTHER USE

The copyright owner's consent does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific written permission must be obtained from the publisher for such copying.

♾™The text paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

The Item-fee Code for this publication is: 0961-9526/91 $3.00 + .00

The cover illustration is known as the composite spheres (cylinder) assemblage and is reproduced with kind permission of Professor Z. Hashin of the University of Tel Aviv.

CONTENTS OF VOLUME 1

NUMBER 1

David Hui	1	Editorial
C.-L. Tsai and **I. M. Daniel**	3	The behavior of cracked cross-ply composite laminates under simple shear loading
R. D. Kurtz and **N. J. Pagano**	13	Analysis of the deformation of a symmetrically-loaded fiber embedded in a matrix material
Kevin P. Walker, Alan D. Freed and **Eric H. Jordan**	29	Microstress analysis of periodic composites
Victor Birman and **George J. Simitses**	41	Buckling and bending of cylindrically orthotropic annular plates
Shive K. Chaturvedi and **Guang Yau Tzeng**	49	Micromechanical modeling of material damping in discontinuous fiber three-phase polymer composites

NUMBER 2

David Hui	i	Editorial
H. A. Whitworth and **S.-W. Yin**	61	A failure criterion for laminated fiber-reinforced composites
Marek-Jerzy Pindera	69	Local/global stiffness matrix formulation for composite materials and structures
A. K. Mal, C.-C. Yin and **Y. Bar-Cohen**	85	Ultrasonic nondestructive evaluation of cracked composite laminates
Michał Basista and **Dusan Krajcinovic**	103	Brittle deformation of disordered solids
C. C. Yang, W. B. Tsai, S. Qin, T. Mura, S. Shibata and **T. Mori**	113	Crack arrest by strong, long fibers in a brittle-matrix composite

NUMBER 3

David Hui	127	Editorial
Chun-Hway Hsueh and **Paul F. Becher**	129	Some considerations of bridging stresses for fiber-reinforced ceramics
Y. Ulcay, B. Pourdeyhimi and **I. Block**	145	Mechanical performance of ultra-high-strength polyethylene fibers

H. M. Shang, C. C. Soh and F. S. Chau	157	The use of carrier fringes in shearography for locating and sizing debonds in GRP plates
R. A. Schapery	167	Analysis of damage growth in particulate composites using a work potential
		Short Note
Sheau-Fan Ma and M. W. Wilcox	183	Thermal buckling of antisymmetric angle-ply laminated cylindrical shells
		NUMBER 4
David Hui	193	Editorial
P. Pintado, T. J. Vogler and J. Morton	195	Impact damage development in thick composite laminates
Konrad Dorninger	211	A nonlinear layered shell finite element with improved transverse shear behavior
Victor Birman and Mark G. Magid	225	Closed-form solutions of static and dynamic problems of long, composite cylindrical shells
G. J. Turvey and M. Y. Osman	235	DR large deflection analysis of orthotropic Mindlin plates with simply-supported and clamped-edge conditions
C. W. Smith and C. T. Liu	249	Effects of near-tip behavior of particulate composites on classical concepts
		NUMBER 5
David Hui	259	Editorial
François Devries	261	Constitutive equations for unidirectional composites with imperfect bonding. The case of elastic, viscous or viscoelastic slipping
Erian A. Armanios and Jian Li	277	Interlaminar stress predictions for laminated composites under bending, torsion and their combined effect
W. J. Cantwell, M. Büsser and H. H. Kausch	293	An analysis of the impact response of a composite beam
Judah Ari-Gur and David H. Hunt	309	Effects of anisotropy on the pulse response of composite panels
David H. Allen and Jong-Won Lee	319	Matrix cracking in laminated composites under monotonic and cyclic loadings
		NUMBER 6
David Hui	335	Editorial
Serge Abrate	337	Matrix cracking in laminated composites: A Review

I. M. Daniel and **C. L. Tsai** 355 Analytical/experimental study of cracking in composite laminates under biaxial loading

J. W. Kaczmar and **K. U. Kainer** 363 Properties of PM-manufactured 6061 Al-base composite materials strengthened with δ-alumina fibers

George J. Simitses and **John S. Anastasiadis** 375 Buckling of axially-loaded, moderately-thick, cylindrical laminated shells

Y. Zhao, S. S. Pang and **S. A. Griffin** 393 Force–indentation study of transversely isotropic composite materials using a conical-tip indenter

i Index for Volume 1, 1991